Meteorological Discoveries,

—BY—

ISAAC P. NOYES.

Washington, D. C.

Reprint from Kansas City Review of Science and Industry, August, 1884.

Meteorological Discoveries.

ISAAC P. NOYES.

Discovery is the act of obtaining facts in regard to any subject. The great discoverers of the world are they who have ascertained facts in relation to the conditions of nature. The higher the type of the discoverer the more cause and effect will enter into his composition, and the more his work will reveal it. Not only will he seek to discover facts, but also the relations which these facts bear to each other and the results of their influence upon the forces of nature. No matter how capable a discoverer may be, no matter what his powers of mind and body, he is more or less hampered by his surroundings.

The globe on which we live, even at this late day is not entirely discovered, and although the undiscovered portions are comparatively small, no one at present can tell what influence their discovery will have upon the human race.

Although the world was highly civilized and had, centuries ago, made astronomical discoveries, whereby it knew about the heavens, and geographical discoveries, whereby it knew of the earth, up to within a very late period it knew little, comparatively nothing, about that great stratum immediately above us, which we term the atmosphere. Until we had a Weather-Map, covering considerable extent of territory, it was impossible to obtain such data as would put us in the way of acquiring the necessary information. It may be asked, why we did not have this map at an earlier day? We might ask, why the "Western Hemisphere" was not discovered at an earlier day, why it was that the civilized world did not sooner learn that the earth was round? Indeed, in this line we might ask pertinent questions by the score. We would get but one general reply —the world was not prepared to obtain this knowledge sooner than it did,—the upper stories of a structure cannot be built before the foundation and the walls of the lower stories are completed. The perfection of meteorology, whereby we become familiar with that stratum of nature between the heavens and the earth, depended upon the perfection of other things which lead up to it. Years ago when we studied physical geography we thought that we knew, or must know about all that there was on this subject.

Wise men had given it their studious attention, but studious attention was of little avail without the means of obtaining facts all important in the matter. Other able men must first advance in the department of electricity and perfect

that, give us the telegraph and all the other necessary paraphernalia for gathering the important facts, whereby the transmission and the use of data was made practical. Wonderful are all the necessary perfected steps which lead up to this important branch of human knowledge; indeed do they come under the head of "too numerous to mention." The clear intellect, even with the unaided eye could obtain a very complete knowledge of the heavens. By the aid of ships, and a few instruments, whereby the unknown seas could be navigated, we could discover the unknown continents, but in order to discover these regions which lie between the heavens and the earth—between the celestial and terrestrial spheres, we must wait many long centuries until we had so subdued the forces of nature to our control that we could use them to conquer these other forces which were apparently beyond our reach. But step by step we were lead up to them, and to day, through these acquired agencies, the laws which govern the forces which form this middle domain of nature and which have such an influence upon us, are as well known as the terrestrial conditions with which we are so familiar; that is, we are, or can be familiar with them on the same principle that we are familiar with other things about us—by seeking information in the right direction and from the right source. "Where may this be found?" it may be asked. On the Weather-Map. The Weather-Map followed up day by day will reveal all to us; and it is the medium and the only medium whereby we may understand this subject.

"But what about physical geography?" may be further asked. Physical geography most certainly should embrace meteorology, as a department embraces a bureau, but meteorology up to within a few years, had no knowledge of the Weather-Map—indeed even late editions of physical geography make no mention of the map, and yet this wonderful instrument has been in existence, here in the United States since 1870. At first, however, it was necessarily crude, but about 1876, or thereabout, it had reached quite a degree of perfection, and yet the persons whom the world would have thought would have been the most eager to seek revelations from it were the very ones to neglect it and continue to publish works upon the general subject, "physical geography" with little or no attention to this all important branch which alone can impart the necessary information.

Physical geography so far as it pertains to meteorology, without the knowledge that may be derived from the Weather-Map, is comparatively of no value, and at this age of the world better be dropped altogether.

The Weather-Map is a most peculiar thing. It does not reveal its secrets like a book, or even like a picture; for this reason few pay much attention to it, and therefore fail to see and perceive the wisdom that it imparts. It must be followed up, day by day, week by week, month by month, year by year; and as it is never twice alike—always different—showing the dominant force in nature for the time being, these forces never bearing the same relation to each other—man can study this wonderful Geography of the Atmosphere for all time, and to the end of time continue the study; and then, after all this study, the changes which take place will be as new and fresh to him as the next new face he meets

in his daily walk. Although physical geography should include meteorology, by reason of the map, the sub-department becomes independent and all important by itself. We will study physical geography when we wish to know about the terrestrial conditions which surround us but when we wish to know something of what we may term the middle stratum, the bridge between earth and heaven, we will consult the Weather-Map. This is speaking of things as we find them to-day. The physical geography of the future, however, will include this. The great wonder, however, is that those who are authors and publishers of physical geography have so long ignored so much light, and the only medium whereby light and information could be gained on so important a subject. All persons should be informed in regard to the Weather-Map, and all intelligent people should be able to know something practical about a storm, when it is approaching, from what quarter, when and how it is likely to clear off, and more than this, should be able to protect themselves against all impostors, and all silly, erroneous, and superstitious sayings on this subject. And, by-the-way, there is no department of nature so replete with these sayings, as the weather, for the simple reason, as seen in all departments of human knowledge, where there is darkness then will there be all degrees of foolishness, from the harmless to that which is most injurious. When man has no real knowledge he readily resorts to the imagination, and the lower his nature and the greater his ignorance, the lower his conceptions of cause and effect.

The Weather-Map with its wonderful revelations came late to the world, yet the authors of our physical geographies should have been ready to receive it when it came, but they were not. Their influence by this time might have added much light and corrected many wrong impressions, but they choose rather to ignore the light than to seek it and profit by it.

To-day, meteorology is still taught, or better, attempted to be taught, on the old plan; might as well undertake to teach pupils geography with the books and light of the fourteenth century as to attempt, to-day, to teach them meteorology without the Weather-Map. The reader may think I am too eulogistic and simply trying to "write up" something beyond its value. All I have to say to such as may think so, is, to study the map thoroughly and note its revelations day by day. Before taking the map, however, let one ask himself what he knows about the weather. After a careful study of the map for a year or two let him compare notes with what he then knows, and what he knew before. If the map has not revealed his former ignorance then he has not been a good observer and made the best use of his time. The great important thing the map reveals to us is that the areas of high and low barometer move across the country on general lines from the west towards the east. "Low," or low barometer is the governing factor, and may be likened unto the valley, while "High" represents the hill. The currents of atmosphere are from the "High" to the "Low." The cause of low-barometer we ascribe to concentrated heat. The great property of heat is to expand or rarify the particles of matter with which it comes in contact. The air at the point "Low" is rarified: the result of this is the inrushing of cold cur-

rents to supply the place of this air so rarified and makes what we call *the wind.* So the movement of atmosphere is always towards "Low." The great reservoir of air is the area of "High" or high barometer. The air rushes along the surface of the earth, from all points of the compass, from "High" towards "Low"; here, by the force of heat, it ascends till it reaches the upper stratum of the atmosphere. From here, judging from the upper movements of the light clouds, the direction is outward from the centre "Low" towards the "High," or better, the upper part of the column "High" to supply the withdrawing of the atmosphere from the bottom of the column "High."

The surface current, or what we term the wind, is, on general lines, from "High" to "Low"—the upper or atmospheric currents from "Low" to "High." At the surface of the earth from the cold to the hot, at the surface of the atmosphere from the hot to the cold—the vacuums as it were being reversed. On the surface of the earth "High" is the highest, "Low" the lowest, while at the top, or upper stratum of atmosphere the highest point would seem to be at "Low" —"Low" the highest, "High" the lowest. When we speak of the movement of the atmosphere, its movement along the surface of the earth, or its terrestrial movement is to be understood. The movement is from the "High" to the "Low." This being the case if "Low" is on a high line of latitude, say at 50° north, or beyond, we will have south winds; and south winds are warm; that is, winds from the far south; the further they are from the south, and the further they travel over the country, the warmer they become. That is why it is, in summer time, often warmer along the northern line of the United States than at the south. But although these areas of Low-barometer travel from the west towards the east they do not do so on any regular line or course. They enter the territory of the United States at various points. On the Pacific their most objective points are above and below Cape Mendocino, the extreme western point of our western border.

This, however, is a mere general statement, for they never enter twice alike and vary with the season and seasons. As a rule they enter and cross the country on a higher line of latitude during the warmer than during the colder months. Others enter at the southwest, or through Mexico and Texas; while still others enter from the region of the West Indies, sometimes striking quite far inland; at other times merely skirting the coast. These latter ones, from want of stations in the West Indies we have very little forewarning of. Although "Low" travels from the west towards the east, it often in its passage, travels on lines almost due north and south for twelve or fifteen hundred miles, and perhaps more. For want of the proper stations we cannot trace its full course. So these "Lows" that come up from the south are undoubtedly ones that are travelling on some erratic course. These areas of high and low-barometer, "High" and "Low," in addition to travelling as above stated, also travel in belts around the world, and all the while vary as to the territory they cover. At times "Low" will be in the north, "High" central, and another "Low" in the south; or we may have "Low" central, with "High" each side. It is always changing, and these changes pro-

duce the changes of the weather from hot to cold, wet to dry; and all the changes are the result of the relation which these two powers "High" and "Low" bear to each other.

The wind being towards "Low," it follows if "Low" is in the north we will have south winds, if in the south, north winds, and these winds partake of the qualities of the locality from which they come. There are times, however, when the north winds will not be very cold nor the south winds very warm, and this will be when these respective winds come from an area of high-barometer that is not very far away. If "High" lies immediately to the north, the north winds cannot be from a great distance north, and if "High is immediately to the south the south winds will not be from far south, therefore will have little opportunity to become heated. "High" is like a great mountain ridge; it is the mountain ridge of the atmosphere. The wind is from the centre of the ridge or highest point of "High;" from the centre outwards, so on the north side of "High" the wind will be towards a north "Low," while on the south side it will be towards a south "Low," etc.

The lines which these areas of "Low" make across the country are infinite, never twice alike; and although their general course is from the west towards the the east, or towards the rising sun, they at times travel due west, but it is always towards the latter part of the day or at night. So soon as the sun reappears in the east and establishes its centre of heat "Low" immediately advances towards it. These areas of Low-barometer not only vary in direction, but in speed, extent and intensity, sometimes being very small, not more than a few hundred miles in diameter, then extending over one-half of the United States and at times they travel not more than a hundred miles in twenty-four hours, at other times they will travel fifteen hundred miles in the same time. And herein is the trouble as regards "indications." We cannot, at least at present, know in advance the direction, the intensity, the speed or the spread, the storm-centre "Low" will take; it is never twice alike nor does it have any periodic similarity. In meteorology there are no special rules to guide us, and that which is past does not, only in a general way, help us much as to what is to come. The study of the map, however, is far more satisfactory than any "indication." But the map can only be studied with satisfaction when near at hand. We can, however, with slight cost, have a substitute which will be nearly as good, and far better than none. The substitute is a skeleton map. Let the people throughout the country have rough outline maps of the United States, divided into squares on the lines of latitude and longitude. Let the size be regulated by convenience. The squares to be designated by letters or figures. The report then to be sent from headquarters at Washington; not only once a day, but say at morning, noon and evening, indicates where the "High" and "Low is, their number, (if more than one), direction, and movement since the last report. Let the public once get accustomed to this system and they would not think of relinquishing it, nor of turning back to even the present system, much less to the ante-diluvian *no-system* which we received from the old school of "physical geography." The new school of phys-

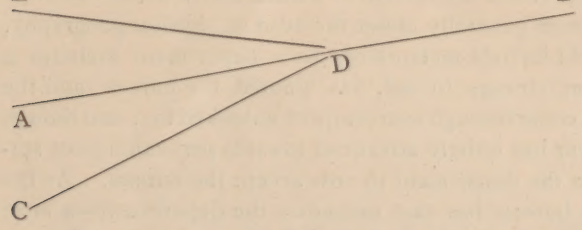
ical geography will embrace the "Weather-Map" as its all important source of information in this department.

As the storm-centres "Low" appear in our west and disappear off the eastern coast and are tracked across the ocean to Europe, so far as we know always disappearing in the east, the inference is that they encircle the earth. We cannot at present prove this, but as we can trace them a quarter the way around the earth and they disappear and reappear in this manner it is not unreasonable to believe that they encircle the earth. The question is often asked, where do storms come from? This idea of encircling the earth being true they do not come from any specified place or quarter, and have no more beginning or ending than a circle, and of them it may well be said, they come from *nowhere*, if the phrase may be understood to conform to the statement in regard to their course and origin. They are ever present on the surface of the earth, varying in shape, in size, intensity, compass and direction, but always having an existence, ever coming and ever going. Late in the season, when we have what is termed "settled weather," as many storm-centres pass us by as during the "inclement season," but they pass us on different lines. During the warmer months a greater number pass us on a high line of latitude and carry heat far to the north, making the north country productive.

Before the advent of the Weather-Map we could not understand that marvel of the year "Indian-summer." The map shows us that it is the effect of an autumnal "Low" on a high line. During the colder months more "Lows" travel on low lines of latitude, making it cold at the south. The "Lows" that produce the most storm, rain or snow, are those which travel on diagonal lines. Whether "Low" will produce rain or snow depends upon its latitude as well as upon the season and the latitude of the section of the country over which it passes. To enumerate all the changes of "High" and "Low," and to show the effects which they have upon the climate of the country would fill volumes. As the changes are infinite the variety must be in proportion; only by the Weather-Map can we be aware of these changes and study their effects. Until we had this wonderful map we had little or no conception of the meteorological phenomena of the world. For example the tornado. The old "physical geography" system had various names for this violent phenomenon, such as *cyclone*, *hurricane*, and *tornado*, and undertook to draw a line between them, giving certain characteristics to one which it did not give to the other. The map reveals the fact that they are all one and the same, and that they proceed from "Low," and under certain conditions of "Low" the different localities of the earth will have the severe storm which may be called by either of these names. The mere description of one of these storms might fill volumes, but from them we gather little or no knowledge of their cause, we only learn of the effect, but follow up the Weather-Map and their cause as well as their effect will be fully revealed. The tornado comes from "Low" and always takes place in the track of this factor, which for short we term "Low." One "Low" passing over the country will not produce the effect, any more than a little fire would in a short time heat

a large room. We must have a succession of "Lows" on a high line, or relatively high line, in order to obtain, through the south winds, the necessary amount of heat. Every "Low," even *high* "Low," will not produce a tornado, if it did we would not only have one every day but every hour of the day all over the country.

The map reveals the fact that the violent wind-storm we call Tornado or Cyclone, when it occurs will always be in the track of "Low" and generally at an acute angle thereto, say an angle of about 15° or 20° to the line of the track of "Low." Let the centre of "Low" one morning be at A; the next morning at B. The tornado will take place on the line C D or E D, or even between the angle C D E, in the track of "Low."



Volumes have been written upon the subject of Climatology, but the subject will never be understood until we seek the proper information from the Weather-Map. By this map we can understand the Climatology of the United States as never before, and when the rest of the world is as well supplied in this respect as the United States we will then and not till then understand the full climatology of the world. The climate of the eastern and western coasts of continents is quite different. Under the old system, which is still present with us, this is all said to be due to the warm currents of the ocean. But the "Weather-Map" now steps in and reveals additional light; and, while at present, from want of stations, we cannot deny but what the warm ocean-currents have something to do with the mildness of the climate, say of our northern Pacific Coast, it does reveal to us that it is not all owing to these currents, but that the position of "Low" has much to do with it and perhaps more than ocean-currents. Land retains heat better than water. To the north of the United States there is a vast domain of land. The map reveals to us that one belt of "Low" passes far to the north of Cape Mendocino, and that the line of this belt varies with the seasons, while the currents remain about the same the year round. Now if the currents remain stationary and the course of "Low" varies with the season it would seem to be good proof that this phenomenon was independent of these currents. This same phenomenon reveals the cause of the peculiar climate of California; a revelation that was not in the power of the old physical geography system to make known. From early in the season till towards the winter months the north "Low," the one that enters the coast to the north of Cape Mendocino works far to the northward. The one that enters the coast to the south thereof also advances northward. From winter to spring these two belts work southward with the Sun. The higher the Sun in the ecliptic the higher the belt of "Low." "High" lies between these two belts and a good part of the year is over the region of San Francisco. The course of these belts varies, for this reason the sea-

sons of this section of the country vary and are never twice alike; but as a rule "Low" passes over this locality quite often from December to April. The higher the Sun in the ecliptic the higher the line of "Low," and the higher the line of "Low" the warmer the temperature on a high line of latitude, and the reverse. Until we had this new revelation it was not possible for us to understand these phenomena of nature. By these discoveries, which come through years of patient toil and advance towards perfection in other branches, we are able, as never before, to comprehend the system of nature under which we live.

Of course this system comes generally under the head of physical geography, and physical geography should include meteorology as a department includes a bureau. But the department, strange to say, has ignored the bureau, and the perfection of the bureau has come through sources quite unlooked for; and though disregarded by the department has quietly advanced towards perfection most surprising. It would be wise in the department to now accept the bureau. As the case stands at present the bureau has fast exceeded the department—a most peculiar circumstance in the annals of science.

It is to be hoped that more and more attention may be paid to this subject. What meteorology now calls for is more and more stations in localities where they will be of the most value. The more we have the more valuable the system becomes, and it would seem that it was time the nations of the earth took this subject in hand. The more universally it is extended the greater the blessing it will confer upon all, the small territory as well as the large, the large as well as the small.

The great middle stratum of our universe is what we particularly want knowledge of. We want to understand the geography of our atmosphere as well as the geography of our terrestrial globe and that of the distant heavens. On this knowledge depends more blessings than is at present realized by the world. The little instrument known as the "Weather-Map," strange as it may seem, is destined to play a most important part in the welfare of the race. The more we contribute to the knowledge of this great undiscovered country, between earth and the heavens, the more happiness we confer upon ourselves. Let the lines of stations advance until we have at least one on a square of two hundred miles—the more we have the better the work, and the greater our knowledge on the subject, the wiser and more reliable weather-prophets we may become, and the greater the blessing we may confer upon mankind.

WASHINGTON, D. C., July, 1884.